

ATTACHMENT 9. ECONOMIC ANALYSIS – FLOOD DAMAGE REDUCTION AND COSTS AND BENEFITS

***Projects analyzed: Lower Carmel River Restoration and Floodplain Enhancement
Carmel River Lagoon and Beach Studies***

ATTACHMENT 9. *ECONOMIC ANALYSIS*
FLOOD DAMAGE REDUCTION AND COSTS AND BENEFITS
LOWER CARMEL RIVER FLOODPLAIN ENHANCEMENT

I. Description of the Project and its Relationship to Other Projects in the Proposal

The Lower Carmel River Floodplain Restoration and Enhancement Project (Project) would provide the combined benefits of enhanced flood protection for a portion of flood prone areas in the immediate vicinity of the north bank of the Carmel River east of Highway One and habitat enhancement in the lower 2 miles of the Carmel River floodplain. The Project compliments the Carmel River Lagoon and Beach Studies Sub-Project (Sub-Project) by focusing on completing flood protection benefits in the lower two miles of the Carmel River and completes over 20 years of phased improvements for habitat and flood control enhancement in the area. The project would result in both a physical and hydrologic connection to the Carmel River Lagoon therefore restoring the physical function of the now separated floodplain and lagoon ecosystem.

The Carmel River Lagoon and Beach Studies Sub-Project begins the feasibility phase for identifying a possible flood control and habitat improvement project in the reach of the Carmel River that includes the lagoon, lower half mile of the river channel and the seasonal barrier beach at the river mouth. This feasibility work will examine solutions to avoid flood damages to 24 homes and solutions to managing the Carmel River Lagoon to avoid mechanized breaching of the lagoon. The potential engineered solution to be examined includes a beach barrier wall to be constructed within the north side of the lagoon.

The Project and Sub-Project are the primary flood benefit projects in the Monterey Peninsula, Carmel Bay, and South Monterey Bay Integrated Regional Water Management Plan (IRWM Plan) affecting over 200 residences as well as significant commercial areas, public facilities, and agricultural operations. Much of the focus of the IRWM Plan is the restoration and enhancement of the region's primary water supply watershed and the region's most important ecological feature: the Carmel River. Projects in this proposal package focus on all of the primary issues associated with the Carmel River Watershed: water supply and overdraft on the system, habitat degradation through loss of habitat and habitat disruption, flood damages to urban and agricultural resources, and decline of physical and hydrologic function of the lower Carmel River ecosystem. The Project and Sub-Project also compliments the Carmel River Watershed Volunteer program proposed in this package in that it would provide a project which could be included in the volunteer monitoring efforts and assessments for improvements in the watershed.

II. Description of the Project's Economic Costs and Benefits

The Project involves three major cost items: (1) project design, engineering and environmental review, (2) construction of the flood conveyance causeway and utility relocation, and (3) removal of earthen levees and earthwork for flood channel overbank capacity and finish grading for habitat improvements.

The project will be completed in two main phases. Phase One will be completed from May 2011 – December 2011. Phase One will include:

1. Creating a 36-acre agricultural preserve that is out of the 100-year floodplain
2. Preparing a base area to receive fill from Phase Two of the project
3. Completing rough grade elevations for seasonal wetlands and riparian habitats

4. Initial riparian and wetland plantings

Phase One of the Project is not proposed for funding in this IRWM Implementation Grant as it has sufficient funds to be completed at this time. However, the planning and construction implementation done for Phase One and as they relate to the proposed Phase Two portion of the project are considered opportunity costs and therefore will be included as an economic benefit for the Project as a whole.

These Phase One benefits total \$1,564,000 in construction costs for Phase One.

Phase Two will include:

1. Construction of the flood conveyance causeway
2. Excavation of approximately 1,400 feet of the south bank levee for improved overflows into the Odello east property
3. Deposit of fill consisting of the levee excavation material onto the base area created in Phase One
4. Detailed finish grading for final flood conveyance and habitat restoration

This IRWM Grant Proposal requests funding for costs associated with the construction of the flood conveyance structure and excavation and grading associated with levee removal and flood flow conveyance.

The major costs items for the construction of the Project and its phases are summarized as follows in 2009 dollars. Details of these costs are included in Table 7.

Cost Item	Total Estimated Cost
Land Donation Value	1,500,000
Project Design, Engineering and Environmental Review	\$1,520,000
Construct Flood Conveyance Causeway Structure	\$9,231,635
Levee Removal and Deposition of Fill and Detailed Grading	\$3,150,000

Additional Project Economic Benefits: Opportunity Costs for Avoided Capital Costs

It is important to note that construction of the flood conveyance causeway and removal of the levees to create new capacity for flood flows on the south bank Odello property results in two opportunity costs for the Project area, notably for the CSA 50 area and Highway One, and will provide planning and construction related economic benefits within the local and regional economy. Short term economic benefits associated with professional services necessary for project design and construction, materials purchased for construction, and actual construction of project improvements are expected to occur in 2011 and 2013.

The opportunity costs to CSA 50 and Highway One are related to future capital improvements that will need to be completed in the Project area within the next 10 years and which were recommended in the Philip Williams & Associates 2002 report and have been identified by Cal Trans.

CSA 50 Area: These improvements include the construction of levee and flood wall improvements on the north bank of the river from Mission Fields Little League Field to the east end of Val Verde Road and installation of greater capacity pumps for handling a wider range of storm events. Both of these improvements would be positively affected by the proposed Project capital improvements and both improvements would likely be less costly due to reduce size, length, and capacity because flood flows would be greatly reduced in these areas. These improvements were

estimated to cost \$3,300,000 in the 2002 Philip Williams & Associates report. These improvements will be re-evaluated once the Project is built with an anticipated reduction in project costs.

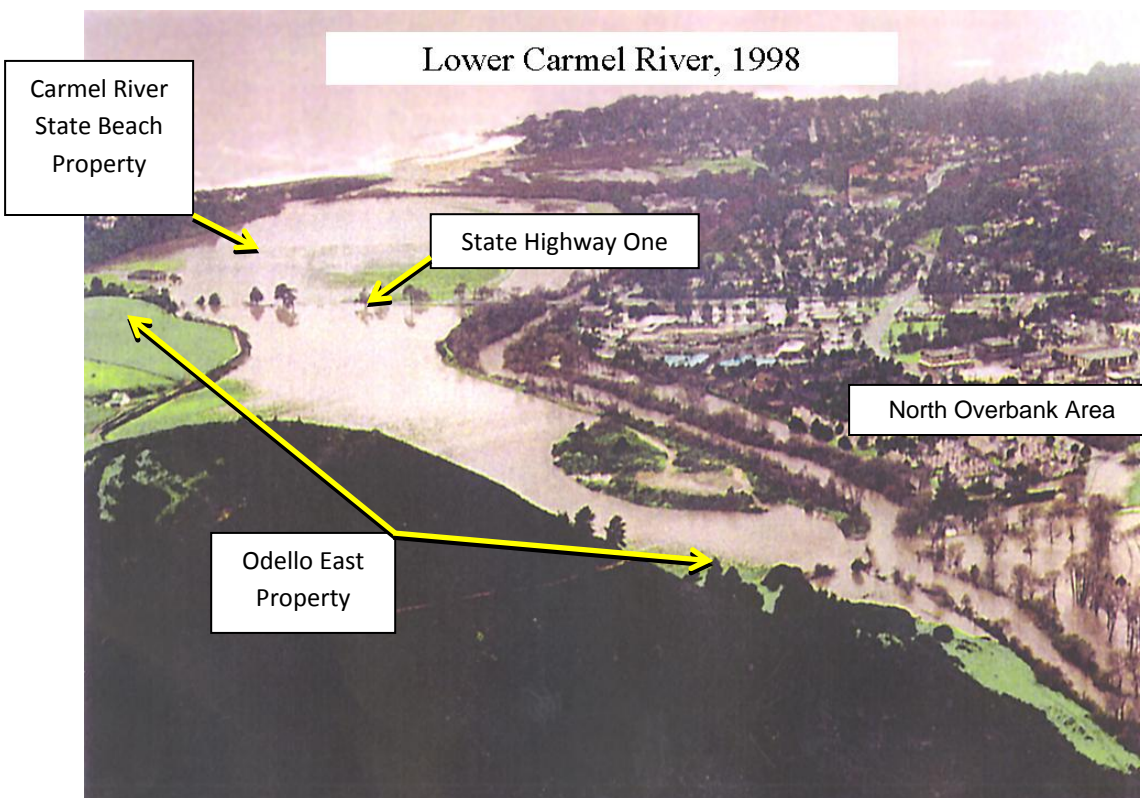
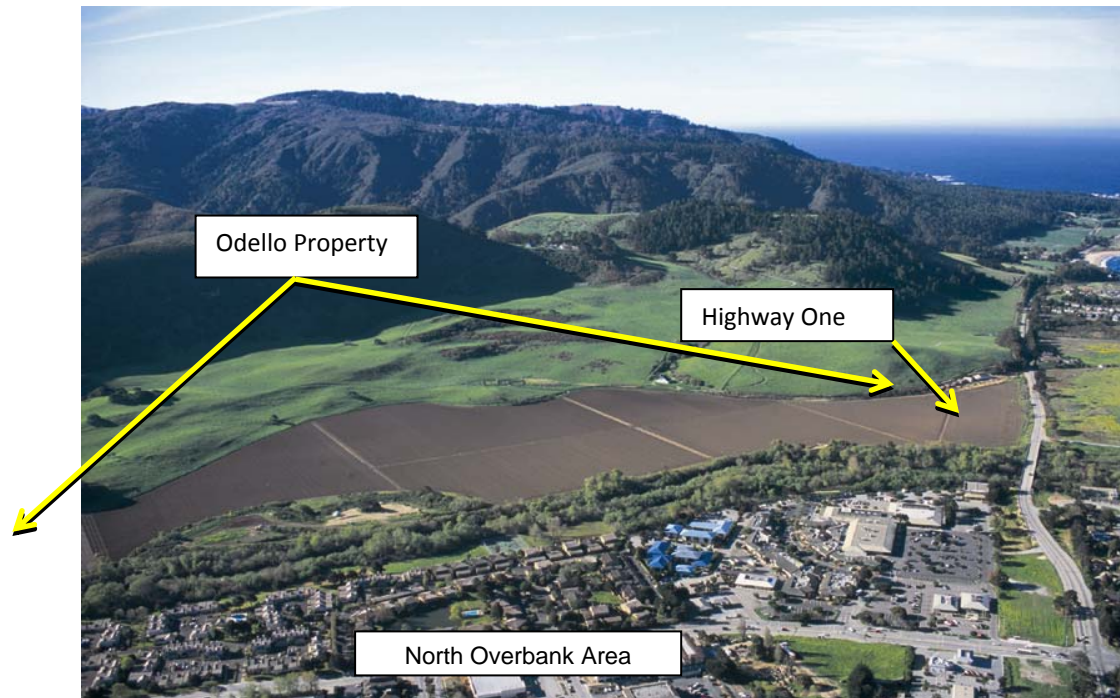
Highway One and Caltrans Maintenance Costs: Another opportunity cost which will result from the construction of the project will be the reduced costs of maintaining the existing 4 - 30" culverts under Highway One and the replacement of the culverts over their lifetime. Cal Trans had programmed these replacements in the next 10 years at an estimated cost of \$1,000,000 replacement cost for the four culverts. The flood conveyance causeway will eliminate the need for at least two and likely three of these culverts and will provide an area under Highway One which will not be restricted for flood flows or associated debris with flood flows.

III. Expected Flood Damage Reduction Benefits

Historical Flood Damage in the Project Area

The area of the proposed Project has sustained numerous floods throughout the years with documented floods occurring from 1911 through present years. The most damaging floods on record include the 1955, 1958, 1995, and 1998 floods. Damage estimates for 1995 and 1998 are available through Monterey County Water Resources Agency. The 1995 flood affected properties and public facilities in the project area causing an estimated \$7 million in damages in 1995 dollars (\$10,520,000 in 2009 dollars). These damages included the complete loss of the State Highway One Bridge and flood damage to residential and commercial properties including 220 residences in Mission Fields and flooding of the Crossroads commercial complex and Rio Road commercial businesses. The loss of the Highway One Bridge resulted in elimination of access to Carmel Highlands and Big Sur for six weeks and necessary evacuations by helicopter for those areas. The bridge was replaced at an estimated cost of \$5 million in 1995 (replacement cost is \$5,700,000 in 2009 dollars). Also during the 1995 and 1998 events, sewage treatment was disrupted in the lower Carmel River residential and commercial areas. A State of Emergency was declared during both these events.ⁱ

Figure 1 shows the Project area and Figure 2 shows the Project area during the 1998 flood.



The following photos show Carmel River Bridge washing away in 1995 flood.



Highway 1 Bridge over the Carmel River
Above - March 10, 1995
Below - March 12, 1995



The Project area affects three land areas in the lower floodplain which include a number of private homes, public facilities, and commercial businesses. These land areas are described below and denoted on the figures.

(a) South Side River Lands (Odello East and West Properties): Lands on the south side of the river include the Odello agricultural lands on the east side of Highway One, State Park land at Carmel River State Beach and Odello West, and the Carmel Area Wastewater District entry road and facility. The total land area is approximately 300 acres on the south side of the River. This area receives flood waters from events larger than a 20-year flood resulting in effects to agricultural operations at Odello East, restricting public access and recreation at Carmel River State Beach, and restricting access to the road to the Carmel Area Wastewater District Sewage Treatment Facility.

Estimated damage from a flood event to Odello East property includes loss of agricultural revenues from crop loss and damages estimated at \$240,000. The basis for this is agricultural lease value of \$30,000 per acre at an operational acreage of 8 acres of land. This is a conservative estimate of possible farmable acreage which is closer to 36 acres total but assumes only a portion of the crop may be damaged by flood waters in any given event.

Additional damages which may occur and have in the past include damage to the access road for the Carmel River Wastewater Facility and disruption of access to Carmel River State Beach. These are estimated at \$50,000 from historical flood events and repair necessary for the Carmel Area Wastewater District facility access road. This road was damaged in the 1995 flood and needed replacement.

(b) CSA-50 Service Area/North Bank of River: Land and developed area included in County Service Area No. 50 (CSA 50) a county designated assessment service area. The total area within CSA 50 boundary consists of 146.8 developed acres. Flood events in excess of the 20-year storm impact this area. For the purposes of this discussion the *Benefit Quantification included in the Lower Carmel River Flood Control Project Final Report, August 2002, pp. 44-52* have been used and updated to 2009 values. ⁱⁱ

The Benefit Quantification identified three land use types that would be impacted by flooding within the CSA 50 area: low-density residential, medium-density residential and commercial. The estimated number of residential units and commercial area square footage of each these land use types in the CSA-50/North Bank area is included in the following table for a 50-year and 100-year storm.

50-year Storm	No. of units/square footage affected	100-year Storm	No. of units/square footage affected
LDR units	170	LDR units	198
MDR units	54	MDR units	167
Commercial	848,000	Commercial	1,163,000

According to the Monterey County Flood Management Plan the mean annual flood damage for repetitive loss reports for residential properties in CSA 50 is \$1,092,644 with a low of \$109,264 and a high of \$2,076,023. These are estimates from 2002 analysis based on 1995 flood data. 2009 values for these are \$1,300,247 for the mean, \$130,024 for the low, and \$2,470,467 for the high.

(c) State Highway One: State Highway One traverses the floodplain from north to south and includes the Carmel River Bridge a slab structure bridge rebuilt in 1995 after the flood of March 1995 destroyed the bridge and washed it away. The 1995 flood was estimated as a 20 - 25-year flood event. State Highway One is susceptible to flooding

during events larger than a 10-year event and can sustain damage in larger flood events (see following discussion HEC-RAS modeling of flood elevations at Highway One). The bridge replacement cost in 1995 was \$5 million dollars. This value is \$5,700,000 in 2009 dollars using the update factor 1.41 provide by the Department of Water Resources.ⁱⁱⁱ

The total historic damages from flood events occurring from the Carmel River in the Project area is was \$7,000,000 in 1995 dollars and included the Highway One Bridge, CAWD access road, and damages to Crossroads and Rio Road commercial areas and residential units in Mission Fields and north bank areas . Values for these damages in 2009 dollars is \$10,520,000 based on a discount factor provided by Department of Water Resources.

Existing Without-Project Conditions

A number of analyses have been conducted for the “without-project” conditions for the flood events in the Project area. These studies and analyses include:

- U.S. Army Corps of Engineers, Flood Plain Information Carmel River, Prepared for Monterey County, 1967.
- Federal Emergency Management Agency, Flood Insurance Study for Monterey County – Unincorporated Areas, 1991.
- Nolte and Associates, Lower Carmel River Flood Control Report: Engineering Report, 1989.
- Monterey County Water Resources Agency, Repetitive Loss Report for Monterey County, unpublished.
- Balance Hydrologics, Inc., Design Alternatives Analysis for Floodplain Restoration at the Odello property, prepared for the Big Sur Land Trust, May 2007.
- Balance Hydrologics Inc., Supplemental Analyses for Floodplain Restoration at the Odello Property, Prepared for the Big Sur Land Trust, June 2008.
- Monterey County Water Resources Agency, Monterey County Flood Management Plan, 2008 Update.
- Federal Emergency Management Agency, Effective Flood Insurance Study for Carmel River, April 2, 2009.

These studies and reports have shown that there is a number of properties (residential and commercial) and public facilities in the floodplain of the Carmel River that experience flood damages during events larger than a 25-year storm and occurrences of damages from lesser storm events (10-year).

The estimated 100-year flood event is 23,300 cfs by the Federal Emergency Management Agency.^{iv} The peak flow of record on the Carmel River was the March 10, 1995 flood event which was gauged at 16,000 cfs estimated as equivalent to a 20 to 30-year flood.

According to recent analysis utilizing the U.S. Army Corps of Engineers HEC-RAS software and conducted by Balance Hydrologics, Inc.^v flood prone areas in the Project vicinity for the existing 100-year analysis are summarized as follows:

- Carmel Area Wastewater District Sewage Treatment Plant – Flooding depths of 4 feet on average were estimated at this facility. Flows in this area were estimated at 6200 cfs.
- State Highway One and associated commercial businesses – The highway as it crosses the south river floodplain area at Odello East would be inundated to a maximum depth of 3.6 feet with a total inundation width of 1,200 feet. 2-5 feet flooding depth was predicted at Carmel River Inn. Flows in this area were estimated at 15,000 cfs.
- CSA 50 (North Bank of River) – Depths of less than one foot of overtopping at north bank levee were

modeled along the north bank upstream of Highway One along Val Verde Drive. Flows in this area were estimated at 2500 cfs.

Modeling results for the 10-year event indicate significantly reduced flooding impacts with the primary point of concern at Highway One where the road crosses the south overbank at Odello Fields. Flows were estimated to overtop the roadway at a maximum depth of 1.5 feet; however, this estimate is likely conservative given that the model did not take into account the large storage volume that exists in the south overbank behind the raised highway that can potentially attenuate the peak flow generated from a 10-year event.^{vi}

An overall assessment of the modeling results suggests that under existing conditions the Odello East and West lands are being utilized to some extent to route flow away from the main channel and the north overbank areas during floods. From a flood control perspective this benefits the developed north overbank at the cost of increased overtopping downstream of Highway One. These studies also demonstrated that flood protection alternatives such as removing the levees only or lowering the levees would disrupt this balance and result in increased flooding impacts in one location or another. For this reason the Project was developed to include the flood conveyance causeway as a necessary feature for increased flood protection in the area along with levee removal and habitat restoration.

Future With-Project Conditions

The Project that is proposed includes the construction of a 500-foot flood conveyance structure at Highway One in the south overbank area adjacent to the Odello East property (see **Figure 4 of Work Plan**). Other proposed actions include excavation of approximately 1400 linear feet of the south bank levees, fine grading of the levees and floodplain to allow flows into Odello East, and habitat restoration. According to the *2007 Balance Hydrologics, Inc. Design Alternative Analysis for Floodplain Restoration at the Odello Property*, the added conveyance provided by the causeway would allow for increased flood flows to be routed through the south overbank areas of Odello East and West and would result in lowering water surface elevations along the north overbank area, without resulting in an increase in the magnitude and frequency of the overtopping at Highway One.

The modeling results from these project improvements project a reduction in flooding within the north overbank can be achieved during the 100-year flow event. Projected reductions in flow rates is 20 percent of existing flow rates and water surface elevations are projected to be reduced 0.8 feet to 2.8 feet. Flow depths within the Odello property were also shown to drop allowing for the terraced agricultural preserve area to remain dry during events smaller than the 10-year flood.

According to the 2007 Balance Hydrologics, Inc. analysis, modeling results also indicated that Highway One would no longer be inundated during the 100-year flood event and that the Odello property would see a 53 percent increase in flow at Highway One. The subsequent decrease in flow within the main channel downstream of Highway One would result in lowering water surface elevations adjacent to the Mission Fields neighborhood by approximately 1.2 to 2.9 feet during the 100-year flood.

Methods Used to Estimate Without- and With- Project Conditions

All analyses used to develop the project description and goals were developed using HEC-RAS software utilizing the 2008 FEMA Flood Insurance Maps. Additional modeling was conducted utilizing the Finite Element Surface Water Modeling System-Two Dimensional Hydrodynamic (FESWMS-2DH) coupled with the Surface-water Modeling System (SMS) graphical pre- and post-processor software. This modeling platform is widely accepted and recommended by

Caltrans for use in modeling highway river crossing where complex hydraulic conditions exist. All work was performed between 2007 and 2008 by Balance Hydrologics, Inc.

IV. Description of the Distribution of Local, Regional, and Statewide Benefits, as Applicable

The Project addresses a well-documented flood prone area in the lower Carmel River. Its benefits have local, regional and statewide economic benefits. Local benefits include reduction of damages to residences, commercial businesses and local infrastructure and facilities. Avoiding these damage costs is expected to benefit the local government and local economy. Regional and statewide benefits include prevention of loss of sales tax revenue from the area and protection of state infrastructure including State Highway One and Carmel River State Beach; both state owned properties. Carmel, Carmel Valley, and the Big Sur area receive over 13 million visitors annually which benefits both local and state economies. The Project will help prevent loss of access to these important statewide tourism areas including up three State Parks in the immediate area and six others in Big Sur.

The Lower Carmel River Floodplain Restoration Project will also help protect the local community against effects of global warming. Projections for climate change impacts on California's coast include more violent and intense flooding events as well as a rise in sea level by as much as three feet. Restoring and conserving functional floodplain area in the coastal zone is consistent with the Coastal Zone Protection Act of 1996, which urges states and communities to manage coastal development so as to minimize the loss of life and property caused by improper development in areas likely to be affected by or vulnerable to sea level rise.^{vii} The natural estuary/floodplain will provide a protective buffer against sea level changes better than any man-made system of levees would be able to provide, while eliminating the potential for additional development in the coastal zone. Furthermore, restoring floodplain, riparian, and wetland vegetation to the project site will help increase carbon uptake and contribute to reduced CO₂ loading in the atmosphere.

V. Identification of Beneficiaries, When the Benefits will be Received, Uncertainty of Benefits and Description of Any Adverse Effects

The beneficiaries of the Project will be the properties within Project area described above. This includes approximately 220 structures of either residential or commercial nature. The Project will also benefit the Carmel River and its habitats, including the Carmel River Lagoon, all of which are important public trust resources for the State of California. The Project will result in approximately 90 acres of restored habitat for the Carmel River.

The flood reduction benefits of the project can be realized by 2013 after construction of the flood conveyance causeway and levee removal. The associated habitat improvements will take approximately five years to mature for wildlife benefit. Water quality benefits related to sediment and nutrient deposition on the floodplain are expected to be immediate benefits as well after construction in 2013. Benefits are not expected to be uncertain or adverse if the Project can be constructed according to design and can be implemented within a reasonable time frame of one another.

Effectiveness could be affected if Phasing is delayed between Phase One and Two of the Project, although increased damages would not result from such a delay. However, the flood control benefits would not be realized if Phase Two was not completed due to the inability to remove the south bank levees if the flood conveyance structure was not constructed. It has been determined through project modeling that the levees cannot be removed to allow flood flows into the south bank and Odello East area unless the flood conveyance structure is built due to flooding at Highway One.

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- ⁱ Monterey County Water Resources Agency, *Monterey County Flood Management Plan*, 2008 Update.
- ⁱⁱ Philip Williams & Associates, Ltd., *Lower Carmel River Flood Control Project Final Report*, August 9, 2002, Prepared for Monterey County Water Resources Agency and County Services Area 50.
- ⁱⁱⁱ Update factor provided by Department of Water Resources by email December 29, 2010.
- ^{iv} FEMA, Effective Flood Insurance Study for Carmel River, April 2, 2009
- ^v Balance Hydrologics, Inc. Design Alternatives for Flood plain restoration at the Odello Property, prepared for the Big Sur Land Trust, May 2007.
- ^{vi} Balance Hydrologics, Inc. May 2007.
- ^{vii} National Oceanic and Atmospheric Administration, Coastal Zone Management Act of 1972 as amended through P.L. 104-150, The Coastal Zone Protection Act of 1996. 16 U.S.C. §1452. Congressional declaration of policy (Section 303).

Table 17- Annual Cost of Project (All costs should be in 2009 Dollars) Lower Carmel River Floodplain Restoration and Enhancement Project									
	Initial Costs	Operations and Maintenance Costs						Discounting Calculations	
YEAR	(a) Grand Total Cost From Table 7 (row (i), column(d))	(b) Admin	(c) Operation (project does not require operating)	(d) Maintenance (assume vegetation man for desired roughness)	(e) Replacement (none)	(f) Other	(g) Total Costs (a) +...+ (f)	(h) Discount Factor	(i) Discounted Costs(g) x (h)
2011	\$2,920,000	\$20,000	\$0	\$10,000	\$0	\$0	\$2,950,000	0.890	\$2,625,500
2012	\$0	\$20,000	\$0	\$10,000	\$0	\$0	\$30,000	0.840	\$25,200
2013	\$12,382,000	\$100,000	\$0	\$10,000	\$0	\$0	\$12,492,000	0.792	\$9,893,664
2014	\$0	\$50,000	\$0	\$10,000	\$0	\$0	\$60,000	0.747	\$44,820
2015	\$0	\$10,000	\$0	\$15,000	\$0	\$0	\$25,000	0.705	\$17,625
2016	\$0	\$10,000	\$0	\$15,000	\$0	\$0	\$25,000	0.665	\$16,625
2017	\$0	\$10,000	\$0	\$15,000	\$0	\$0	\$25,000	0.627	\$15,675
2018	\$0	\$10,000	\$0	\$15,000	\$0	\$0	\$25,000	0.592	\$14,800
2019	\$0	\$10,000	\$0	\$15,000	\$0	\$0	\$25,000	0.558	\$13,950
2020	\$0	\$10,000	\$0	\$15,000	\$0	\$0	\$25,000	0.527	\$13,175
2021	\$0	\$10,000	\$0	\$20,000	\$0	\$0	\$30,000	0.497	\$14,910
2022	\$0	\$10,000	\$0	\$20,000	\$0	\$0	\$30,000	0.469	\$14,070
2023	\$0	\$10,000	\$0	\$20,000	\$0	\$0	\$30,000	0.442	\$13,260
2024	\$0	\$10,000	\$0	\$20,000	\$0	\$0	\$30,000	0.417	\$12,510
2025	\$0	\$10,000	\$0	\$20,000	\$0	\$0	\$30,000	0.394	\$11,820
2026	\$0	\$10,000	\$0	\$20,000	\$0	\$0	\$30,000	0.371	\$11,130
2027	\$0	\$10,000	\$0	\$20,000	\$0	\$0	\$30,000	0.350	\$10,500
2028	\$0	\$10,000	\$0	\$20,000	\$0	\$0	\$30,000	0.331	\$9,930
2029	\$0	\$10,000	\$0	\$20,000	\$0	\$0	\$30,000	0.312	\$9,360
2030	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.294	\$10,290
2031	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.278	\$9,730
2032	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.262	\$9,170
2033	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.247	\$8,645
2034	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.233	\$8,155
2035	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.220	\$7,700
2036	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.207	\$7,245
2037	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.196	\$6,860
2038	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.185	\$6,475
2039	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.174	\$6,090
2040	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.164	\$5,740
2041	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.155	\$5,425
2042	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.146	\$5,110
2043	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.138	\$4,830
2044	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.130	\$4,550
2045	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.123	\$4,305
2046	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.116	\$4,060
2047	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.109	\$3,815
2048	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.103	\$3,605
2049	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.097	\$3,395
2050	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.092	\$3,220
2051	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.087	\$3,045
2052	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.082	\$2,870
2053	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.077	\$2,695
2054	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.073	\$2,555
2055	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.069	\$2,415
2056	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.065	\$2,275
2057	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.061	\$2,135
2058	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.058	\$2,030
2059	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.055	\$1,925
2060	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.052	\$1,820
2061	\$0	\$10,000	\$0	\$25,000	\$0	\$0	\$35,000	0.049	\$1,715
Project Life									
Total Present Value of Discounted Costs (Sum of Column (i))									\$12,942,419
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									
Comments: For Column B - assume costs to Monterey County Water Resources Agency and Monterey County Public Works Department for staff time associated with CSA 50 and agency communications and administration. For Column D assume costs for Monterey County Water Resources Agency and Monterey County Public Works Department for maintenance of vegetation, levees and ponds in Project Area. See CSA 50 Fiscal year report June 30, 2010 and June 30, 2011.									

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Table 18 - Event Damage							
Hydrologic Event	Event Probability *	Damage if Flood Structures Fail	Probability Structural Failure		Event Damage		Event Benefit (Million \$)
			Without Project	With Project	Without Project	With Project	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
					(c) x (d)	(c) x (e)	(f) – (g)
10-Year	0.900	\$240,000	0.0220	0.0086	\$5,280	\$2,064	\$3,216
25-Year	0.080	\$10,520,000	0.0220	0.0086	\$231,440	\$90,472	\$140,968
100-Year	0.008	\$10,520,000	0.100	0.004	\$1,052,000	\$37,872	\$1,014,128

Source: Balance Hydrologics, Inc. using Full Data Module & Limited Data Module.

Table 19 - Present Value of Expected Annual Damage Benefits			
Project: Lower Carmel River Floodplain Restoration and Enhancement Project			
(a)	Expected Annual Damage Without Project (1)		\$151,700
(b)	Expected Annual Damage With Project		\$42,900
(c)	Expected Annual Damage Benefit	(a) – (b)	\$108,800
(d)	Present Value Coefficient (2)		15.76
(e)	Present Value of Future Benefits	(c) x (d)	\$1,714,688
	Transfer to Table 20, column (e), Exhibit F: Proposal Costs and Benefits Summaries.		

(1) *Balance Hydrologics- Full Data Module Version 5.2.5 February 23, 2006 and Limited Data Module, Flood Mitigation Projects Version 5.2.3, May 2, 2006.*

(2) *6% discount rate; assumed 50-year analysis period.*

FUND 077 C.S.A. 50, MISSION FIELDS & LOWER CARMEL RIVER
BUDGETED, ACTUAL, and PROJECTED REVENUES & APPROPRIATIONS
For the FISCAL YEAR ENDING JUNE 30, 2010

DReduc
Supporting Documentation
Lower Carmel River
Floodplain Protection +
Restoration Project

Available Financing	Revenue Budget	Revenue Recorded as of 6/30/2010
Fund Balance as of July 1, 2009	\$ 310,597	\$ 320,717
Acct. 4010 Taxes	\$ 825	\$ 771
Acct. 6400 Interest	\$ 11,200	\$ 8,632
Acct. 5030 Homeowners Tax Relief	\$ 10	\$ 5
Acct. 5415 <u>Service/User Fees</u>	\$ 111,480	\$ 111,272
Total Revenue	123,515	120,680
Acct. 2005 Vouchers Payable Returned	-	\$ 16
Total Available Financing	\$ 434,112	\$ 441,413

Financing Requirements	Appropriations Budget	Obligations Recorded as of 6/30/2010
Acct. 6268 Liability Insurance	\$ 1,000	\$ 1,065
Acct. 6312 Operations, Maint., & Admin.		
→ Shared Admin. Costs	\$ 4,610	\$ 3,586
→ Direct Admin. & Engineering	11,100	3,965
Ponds Maintenance	10,000	4,213
Storm Drain Maintenance	-	-
→ Levee Maintenance	8,000	2,895
<u>Contingencies</u>	-	-
Acct. 6312 Total	\$ 33,710	\$ 14,659
Acct. 6864 Fleet Mngmnt. (Pump Licenses & Maint)	\$ 1,000	\$ 2,996
Acct. 6231 Communications (Pac. Bell)	\$ 200	\$ 203
Acct. 6881 Utilities (P.G. & E.)	\$ 225	\$ 211
Acct. 6601 Accounting & Secretarial	\$ 2,500	\$ 894
Acct. 6613 Professional & Other Services		
County Tax Administration	\$ 20	\$ 11
→ Mntry. Co. Water Resources	10,000	-
<u>Other Professional Services</u>	-	-
Acct. 6613 Total	\$ 10,020	\$ 11
Acct. 6835 Special Dept. Expenses		
Mntry. Air Pollution Control District	\$ 250	\$ -
Ca. Dept. of Fish & Game / Other	-	-
<u>Contingency</u>	385,207	-
Acct. 6835 Total	\$ 385,457	\$ -
Acct. 6384 Miscellaneous	\$ -	\$ -
Acct. 7614 Transfer Out	\$ -	\$ -
Total Financing Requirements	\$ 434,112	\$ 20,039
Estimated Fund Balance at June 30, 2010	\$ -	\$ 421,374
Designated Reserve Fund	\$ 250,000	\$ 250,000

NOTE:

This is a preliminary closing report. The Auditor's Office has not yet finalized Fiscal Year 2010.

CSA 50 FY 2010 Detail of Obligations

	Current Modified BUDGET	Obligations Recorded 6/30/2010
6268 Liability Insurance	\$ 1,000	\$ 1,065
6312 Operations, Maintenance & Admin.		
Adjustments for Prior Year	\$ -	\$ -
810000 Shared Admin Costs	3,000	1,847
810001 Janitorial & Utilities	25	-
810002 Office Supplies & Furn.	-	-
810003 Telephone/Fax Svcs.	75	76
810005 Legal Services/Notices	-	-
810015 Fire Extinguisher Svc.	10	-
815000 Ponds Maintenance	10,000	4,213
815001 CSA 50 Admin./Engineering	11,100	3,965
New Civil Engineer	-	-
815002 Storm Drains Maintenance	-	-
815005 Mission Flds / Rio Rd. Levees Maint.	8,000	2,895
816342 General Training	75	36
816343 Safety Training	25	-
836342 Sanitation Training	-	-
830001 Shared Uniforms Costs	75	13
830002 Emergency Standby Time	1,000	1,266
830003 Shared Bldg E Utility Costs	100	-
830004 Safety Equipment	75	260
830008 Small Tools & Instruments	150	88
Contingency Funds	-	-
6315 Subtotal	\$ 33,710	\$ 14,659
6864 Pump Maint. (Fleet Mngmnt.)	\$ 1,000	\$ 2,996
6231 Direct Communication Costs	\$ 200	\$ 203
6881 Direct Utility Costs	\$ 225	\$ 211
6601 Accting & Secretarial	\$ 2,500	\$ 894
6613 Professional & Other Services		
County Tax Assessors Fees	\$ 20	\$ 11
→ Mntry. Co. Water Resources	10,000	-
Other Professional / Contingency	-	-
6469 Subtotal	\$ 10,020	\$ 11
6835 Special Department Expenses		
Ca. Dept. of Fish & Game Permits / Other	\$ -	\$ -
Mntry. Air Pollution (W.O. 815025)	250	-
Automatic Pump Controller	-	-
Contingency	385,207	-
6499 Subtotal	\$ 385,457	\$ -
6384 Miscellaneous	\$ -	\$ -
7614 Transfer Out	\$ -	\$ -
Grand Total	<u>\$ 434,112</u>	<u>\$ 20,039</u>

CSA 50 - RIOWAY TRACT & MISSION FIELDS
FUND 077 UNIT 8198 RMA073
FINANCIAL SUMMARY FOR THE FISCAL YEAR ENDING JUNE 30, 2011

	Revenue Budget Submitted to the to Board of Supervisors	Revenues Recorded in AFIN as of 11/5/10	Projected Revenues For Fiscal Year Ending 6/30/2011
Fund Balance by July 1, 2010	\$ 408,807	\$ -	\$ 421,374
Transfer in From Reserve	\$ -	\$ -	\$ -
Prior Year Encumbrance Returned to Fund	\$ -	\$ -	\$ -
Revenue			
Accts 4010~4040 Taxes	\$ 835	\$ 11	\$ 761
Acct 4600 Interest	9,800	2,051	8,250
Acct 4675 Other Rents	-	-	-
Acct 5010 State Aid	-	-	-
Acct 5030 Homeowners Property Tax Relief	5	-	5
Acct 5415 Road & Street Services	111,480	-	111,480
Acct 5680 Sanitation Fees	-	-	-
Acct 5750 Other Services	-	-	-
Acct 5940 Transfers In	-	-	-
Total Revenue	<u>\$ 122,120</u>	<u>\$ 2,062</u>	<u>\$ 120,496</u>
Total Available Financing	<u>\$ 530,927</u>	<u>\$ 2,062</u>	<u>\$ 541,870</u>

	Appropriations Budget Approved by the Board of Supervisors	Actual Obligations as of as of 11/5/10	Projected Obligations for Fiscal Year Ending 6/30/2011
Financing Requirements			
Acct. 6231 Communications	\$ 210	\$ 47	\$ 250
Acct. 6268 Insurance	1,065	-	1,065
Acct. 6311 Outside Maintenance Services	-	-	-
➤ Acct. 6312 Operations, Maint., & Admin. Costs	74,562	3,223	18,070
Acct. 6384 Miscellaneous Expenses	-	-	-
Acct. 6406 Mail Handling Charges	2	-	-
Acct. 6413 Graphics	-	-	-
Acct. 6601 Intra-Fund Accting & Secretarial	1,250	215	900
Acct. 6605 Laboratory Services	-	-	-
Acct. 6613 Professional & Other Svcs	50,010	-	15
Acct. 6835 Special Dept. Expenses	399,383	-	250
Acct. 6864 Vehicle & Equipment Maint.	4,195	555	3,000
Acct. 6881 Utilities	250	54	250
Acct. 7051 Debt Principal	-	-	-
Acct. 7082 Debt Interest	-	-	-
Acct. 7121 Taxes & Assessments	-	-	-
Acct. 7303 Reimbursement Clearing	-	-	-
Acct. 7531 Fixed Assets - Equipment	-	-	-
Acct. 7614 Transfers Out	-	-	-
Total Obligations	<u>\$ 530,927</u>	<u>\$ 4,094</u>	<u>\$ 23,800</u>
Provisions for Reserves	<u>\$ -</u>	<u>\$ -</u>	<u>\$ -</u>
Total Financing Requirements	<u>\$ 530,927</u>	<u>\$ 4,094</u>	<u>\$ 23,800</u>
Projected Fund Balance as of June 30, 2011	\$ -	NA	\$ 518,070
Acct. 3115 Fund Balance Reserves by June 30, 2011	\$ 250,000	\$ 250,000	\$ 250,000

NOTE:

The Budgeted column was prepared in Feb of 2010, based on the information available at that time.
The Projected column was prepared in November 2010, based on current information.

CSA 50 FY 2011 Detail of Obligations

	Current Modified BUDGET	Obligations Recorded	Projected Obligations for FYE 6/30/11
6231 Direct Communication Costs	\$ 210	\$ 47	\$ 250
6268 Liability Insurance	\$ 1,065	\$ -	\$ 1,065
6312 Operations, Maintenance & Admin.			
Adjustments for Prior Year	\$ -	\$ -	\$ -
810000 Shared Admin Costs	1,700	529	2,750
810001 Janitorial & Utilities	-	1	-
810002 Office Supplies & Furn.	-	-	-
810003 Telephone/Fax Svcs.	275	1	85
810005 Legal Services/Notices	-	-	-
810010 Engineering Support	4,470	-	-
810015 Fire Extinguisher Svc.	-	-	-
→ 815000 Ponds Maintenance	5,000	1,384	5,000
815001 CSA 50 Admin./Engineering	7,000	318	4,500
815002 Storm Drains Maintenance	2,500	-	-
→ 815005 Mission Flds / Rio Rd. Levees Maint.	7,000	579	4,000
816342 General Training	75	-	45
816343 Safety Training	-	-	-
836342 Sanitation Training	-	-	-
830001 Shared Uniforms Costs	25	2	15
830002 Emergency Standby Time	1,200	409	1,300
830003 Shared Bldg E Utility Costs	75	-	-
830004 Safety Equipment	75	-	275
830008 Small Tools & Instruments	100	-	100
Contingency Funds	45,067	-	-
	<u>74,562</u>	<u>3,223</u>	<u>18,070</u>
6384 Miscellaneous	\$ -	\$ -	\$ -
6406 Mail Handling	\$ 2	\$ -	\$ -
6601 Accting & Secretarial	\$ 1,250	\$ 215	\$ 900
6613 Professional & Other Services			
County Tax Assessors Fees	\$ 10	\$ -	\$ 15
Mntry. Co. Water Resources	-	-	-
Other Professional / Contingency	50,000	-	-
6469 Subtotal	<u>\$ 50,010</u>	<u>\$ -</u>	<u>\$ 15</u>
6835 Special Department Expenses			
Ca. Dept. of Fish & Game Permits / Other	\$ -	\$ -	\$ -
Mntry. Air Pollution (W.O. 815025)	250	-	250
Automatic Pump Controller	-	-	-
Contingency	399,133	-	-
6499 Subtotal	<u>\$ 399,383</u>	<u>\$ -</u>	<u>\$ 250</u>
6864 Pump Maint. (Fleet Mngmnt.)	\$ 4,195	\$ 555	\$ 3,000
6881 Direct Utility Costs	\$ 250	\$ 54	\$ 250
7614 Transfer Out	\$ -	\$ -	\$ -
Grand Total	<u>\$ 530,927</u>	<u>\$ 4,094</u>	<u>\$ 23,800</u>

Return Freq	Probability of Occurrence	Inundation Area (Acres)			
		Residential Low Density	Residential Medium Density	Commercial	Total
10	10%	-	-	-	-
25	4%	-	-	-	-
50	2%	42.50	6.70	55.60	104.80
100	1%	49.60	20.90	76.30	146.80

Land Use Assumptions:			
Low Density Residential	4 Units Per Acre		
Medium Residential	8 Units Per Acre		
Commercial	35% Building Foot Print Coverage		
Inundation Return Frequency (years)	Flooded Property		
	Low Density Residential Units	Medium Density Residential Units	Commercial Building Sq. Ft.
50	170	53.6	847,678
100	198.4	167.2	1,163,270

1205438 total square feet of building
1748230 total square feet of building

Increment of flood damage (\$) per unit		\$ 4,000.00		Increment for damage (\$) per sq. ft.		\$ 2.50	
50 Year	Damage per unit	LDR	MDR	Total Res	Damage per sqft	Commercial	Total Residential and Commercial Damage
	\$ 4,000.00	\$ 680,000	\$ 214,400	\$ 894,400	\$ 2.50	\$ 2,119,194	\$ 3,013,594
	\$ 8,000.00	\$ 1,360,000	\$ 428,800	\$ 1,788,800	\$ 5.00	\$ 4,238,388	\$ 6,027,188
	\$ 12,000.00	\$ 2,040,000	\$ 643,200	\$ 2,683,200	\$ 7.50	\$ 6,357,582	\$ 9,040,782
	\$ 16,000.00	\$ 2,720,000	\$ 857,600	\$ 3,577,600	\$ 10.00	\$ 8,476,776	\$ 12,054,376
	\$ 20,000.00	\$ 3,400,000	\$ 1,072,000	\$ 4,472,000	\$ 12.50	\$ 10,595,970	\$ 15,067,970
	\$ 24,000.00	\$ 4,080,000	\$ 1,286,400	\$ 5,366,400	\$ 15.00	\$ 12,715,164	\$ 18,081,564
	\$ 28,000.00	\$ 4,760,000	\$ 1,500,800	\$ 6,260,800	\$ 17.50	\$ 14,834,358	\$ 21,095,158
	\$ 32,000.00	\$ 5,440,000	\$ 1,715,200	\$ 7,155,200	\$ 20.00	\$ 16,953,552	\$ 24,108,752
	\$ 36,000.00	\$ 6,120,000	\$ 1,929,600	\$ 8,049,600	\$ 22.50	\$ 19,072,746	\$ 27,122,346
	\$ 40,000.00	\$ 6,800,000	\$ 2,144,000	\$ 8,944,000	\$ 25.00	\$ 21,191,940	\$ 30,135,940
	\$ 44,000.00	\$ 7,480,000	\$ 2,358,400	\$ 9,838,400	\$ 27.50	\$ 23,311,134	\$ 33,149,534
	\$ 48,000.00	\$ 8,160,000	\$ 2,572,800	\$ 10,732,800	\$ 30.00	\$ 25,430,328	\$ 36,163,128
	\$ 52,000.00	\$ 8,840,000	\$ 2,787,200	\$ 11,627,200	\$ 32.50	\$ 27,549,522	\$ 39,176,722
	\$ 56,000.00	\$ 9,520,000	\$ 3,001,600	\$ 12,521,600	\$ 35.00	\$ 29,668,716	\$ 42,190,316
	\$ 60,000.00	\$ 10,200,000	\$ 3,216,000	\$ 13,416,000	\$ 37.50	\$ 31,787,910	\$ 45,203,910
	\$ 64,000.00	\$ 10,880,000	\$ 3,430,400	\$ 14,310,400	\$ 40.00	\$ 33,907,104	\$ 48,217,504
	\$ 68,000.00	\$ 11,560,000	\$ 3,644,800	\$ 15,204,800	\$ 42.50	\$ 36,026,298	\$ 51,231,098
	\$ 72,000.00	\$ 12,240,000	\$ 3,859,200	\$ 16,099,200	\$ 45.00	\$ 38,145,492	\$ 54,244,692
	\$ 76,000.00	\$ 12,920,000	\$ 4,073,600	\$ 16,993,600	\$ 47.50	\$ 40,264,686	\$ 57,258,286
100 Year	Damage per unit	LDR	MDR	Total Res	Damage per sqft		
	\$ 4,000.00	\$ 793,600	\$ 668,800	\$ 1,462,400	\$ 2.50	\$ 2,908,175	\$ 4,370,575
	\$ 8,000.00	\$ 1,587,200	\$ 1,337,600	\$ 2,924,800	\$ 5.00	\$ 5,816,349	\$ 8,741,149
	\$ 12,000.00	\$ 2,380,800	\$ 2,006,400	\$ 4,387,200	\$ 7.50	\$ 8,724,524	\$ 13,111,724
	\$ 16,000.00	\$ 3,174,400	\$ 2,675,200	\$ 5,849,600	\$ 10.00	\$ 11,632,698	\$ 17,482,298
	\$ 20,000.00	\$ 3,968,000	\$ 3,344,000	\$ 7,312,000	\$ 12.50	\$ 14,540,873	\$ 21,852,873
	\$ 24,000.00	\$ 4,761,600	\$ 4,012,800	\$ 8,774,400	\$ 15.00	\$ 17,449,047	\$ 26,223,447
	\$ 28,000.00	\$ 5,555,200	\$ 4,681,600	\$ 10,236,800	\$ 17.50	\$ 20,357,222	\$ 30,594,022
	\$ 32,000.00	\$ 6,348,800	\$ 5,350,400	\$ 11,699,200	\$ 20.00	\$ 23,265,396	\$ 34,964,596
	\$ 36,000.00	\$ 7,142,400	\$ 6,019,200	\$ 13,161,600	\$ 22.50	\$ 26,173,571	\$ 39,335,171
	\$ 40,000.00	\$ 7,936,000	\$ 6,688,000	\$ 14,624,000	\$ 25.00	\$ 29,081,745	\$ 43,705,745
	\$ 44,000.00	\$ 8,729,600	\$ 7,356,800	\$ 16,086,400	\$ 27.50	\$ 31,989,920	\$ 48,076,320
	\$ 48,000.00	\$ 9,523,200	\$ 8,025,600	\$ 17,548,800	\$ 30.00	\$ 34,898,094	\$ 52,446,894
	\$ 52,000.00	\$ 10,316,800	\$ 8,694,400	\$ 19,011,200	\$ 32.50	\$ 37,806,269	\$ 56,817,469
	\$ 56,000.00	\$ 11,110,400	\$ 9,363,200	\$ 20,473,600	\$ 35.00	\$ 40,714,443	\$ 61,188,043
	\$ 60,000.00	\$ 11,904,000	\$ 10,032,000	\$ 21,936,000	\$ 37.50	\$ 43,622,618	\$ 65,558,618
	\$ 64,000.00	\$ 12,697,600	\$ 10,700,800	\$ 23,398,400	\$ 40.00	\$ 46,530,792	\$ 69,929,192
	\$ 68,000.00	\$ 13,491,200	\$ 11,369,600	\$ 24,860,800	\$ 42.50	\$ 49,438,967	\$ 74,299,767
	\$ 72,000.00	\$ 14,284,800	\$ 12,038,400	\$ 26,323,200	\$ 45.00	\$ 52,347,141	\$ 78,670,341
	\$ 76,000.00	\$ 15,078,400	\$ 12,707,200	\$ 27,785,600	\$ 47.50	\$ 55,255,316	\$ 83,040,916

Lower Carmel River Flood Control Project
PWA Job No. 1526

Storm Return Frequency	Probability of occurrence in one year	Low Range of Damage Amount	Mean Damage Amount	High Range of Damage Amount
100	1.00%	\$ 4,370,575	\$ 43,705,745	\$ 83,040,916
50	2.00%	\$ 3,013,594	\$ 30,135,940	\$ 57,258,286
25	4.00%	\$ -	\$ -	\$ -
10	10.00%	\$ -	\$ -	\$ -

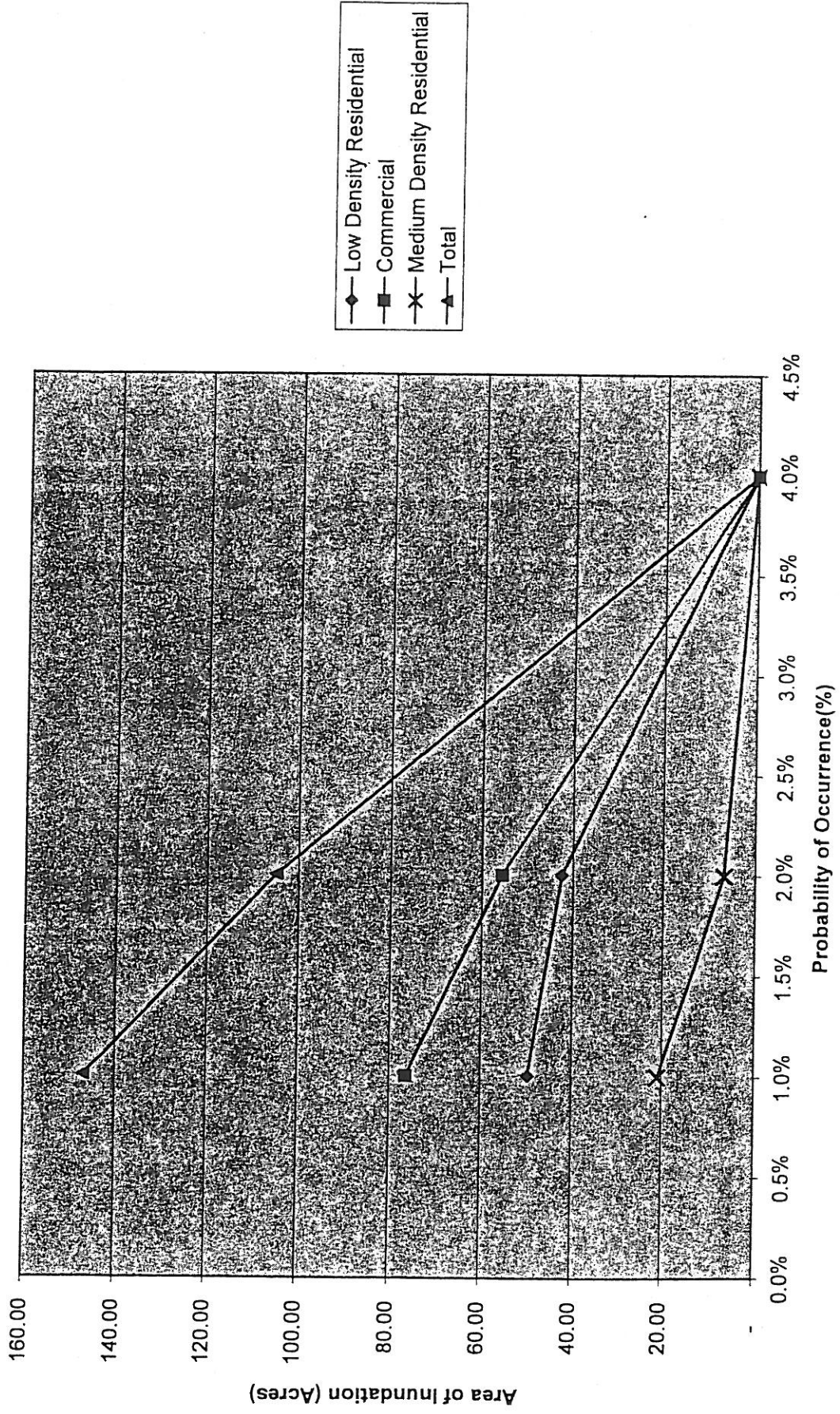
The expected annual flood damage is calculated as the area under the curve				
Mean				
Low Range:				
(1%+4%)/2	x	(100-year low range \$) =		
2.50%	x	\$ 4,370,575	=	\$ 109,264
Mean:				
(1%+4%)/2	x	(100-year mean \$) =		
2.50%	x	\$ 43,705,745	=	\$ 1,092,644
High Range:				
(1%+4%)/2 =	x	(100-year high range \$) =		
2.50%	x	\$ 83,040,916	=	\$ 2,076,023

\$ 0.063 per sq ft

\$ 0.625 per sq ft

\$ 1.188 per sq ft

Lower Carmel River Flood Control Project
Probability vs. Area of Inundation



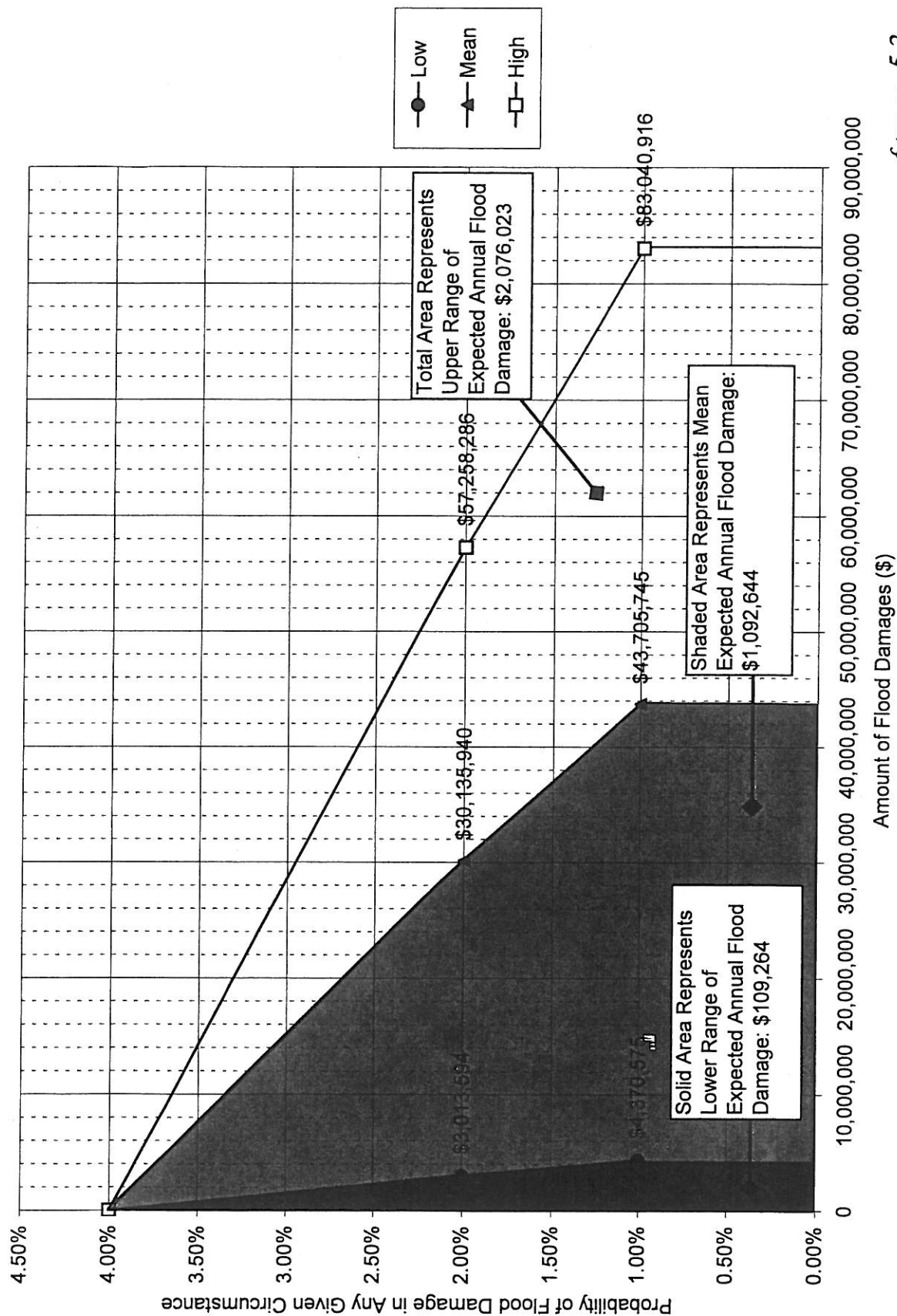


figure 5.3

Lower Carmel River Flood Control Project
Annual Probability of Flood Damage vs. Dollar Value of Damage



Table 1. Tabulated hydraulic modeling results, lower Carmel River

Location	10-Year Water Surface Elevations		100-Year Water Surface Elevations	
	Existing Conditions (feet)	Post-Project Conditions (feet)	Existing Conditions (feet)	Post-Project Conditions (feet)
Main Channel at Waste Water Treatment Plant	16.5	16.0	17.8	17.5
Main Channel at Highway 1 Bridge	22.3	21.1	24.2	23.5
Main Channel at Val Verde Drive	32.3	31.3	36.0	35.0
South Overbank at Highway 1	24.1	19.1	25.6	22.0
North Overbank at Highway 1	-	-	24.5	24.3

The BCA for the Lower Carmel Flood Control Project involves multiple components that are easily incorporated into the BCA Toolkit formats.

The Limited Data Module tool was utilized for benefit calculations for loss of Highway 1 embankment, including severing of utility lines.

Limited Data Module used to calculate benefits of protecting Serendipity Farms on south overbank area

Full Data Modules used to calculate benefits per attached NOB risk factors for properties in the north overbank area (Mission Fields, Rio Road area, Crossroads)

The FDM analyses are based on detailed HEC-RAS modeling of existing and post-project conditions as summarized in the June 2008 project documentation.

FDM analyses are grouped by APN number and are based on detailed survey work to establish FFEs carried out by Whitson Engineers of Monterey, California in October and November of 2008.

CAD file of survey information provided by Whitson is attached to the HMGP application and shows properties used in the FDM analyses.

	Flood Event	Levee Failure		Overtop		Risk	
						Event	Overall
	<10	0.900	N	1.000	N	0.9000	0.0220
					Y	0.0000	
			Y	0.000		0.0000	
Pre-project Event	>10 <50	0.080	N	0.900	N	0.0720	0.0220
					Y	0.0000	
			Y	0.100		0.0080	
	>50 <100	0.010	N	0.600	N	0.0060	0.0140
					Y	0.0000	
			Y	0.400		0.0040	
	>100 <500	0.008	N	0.300	N	0.0000	0.0100
					Y	0.0024	
			Y	0.700		0.0056	
	>500	0.002	N	0.000	N	0.0000	0.0020
					Y	0.0000	
			Y	1.000		0.0020	
							1.00000

	Flood Event	Levee Failure		Overtop		Risk	
						Event	Overall
<10	0.900	N	1.000	N	1.000	0.9000	0.0086
				Y	0.000	0.0000	
		Y	0.000			0.0000	
Post-project Event	>10 <50	N	0.950	N	1.000	0.0760	0.0086
				Y	0.000	0.0000	
		Y	0.050			0.0040	
>50 <100	0.010	N	0.900	N	1.000	0.0090	0.0046
				Y	0.000	0.0000	
		Y	0.100			0.0010	
>100 <500	0.008	N	0.800	N	1.000	0.0064	0.0036
				Y	0.000	0.0000	
		Y	0.200			0.0016	
>500	0.002	N	0.200	N	0.000	0.0000	0.0020
				Y	1.000	0.0004	
		Y	0.800			0.0016	
						1.00000	

ATTACHMENT 9. *ECONOMIC ANALYSIS – FLOOD DAMAGE REDUCTION AND COSTS AND BENEFITS – CARMEL RIVER LAGOON AND BEACH STUDIES*

Flood damage reduction is a primary benefit of this EPB project, as follows:

Avoided physical damage:

- Residences in 10-year floodplain on north side of Lagoon (approx. 24 residences)
- Contents of residences
- Landscaping of residences
- Vehicles of residents

Avoided loss of functions:

- Net loss of utility services in approx. 24 residences
- Displacement costs of temporary quarters (residents having to stay in nearby hotels or motels)

Avoided emergency response costs

- Evacuation and rescue of residents costs by County
- Dewatering, debris removal and cleanup costs

(narrative and estimated costs to follow)

Prevention of flooding of homes from a coastal flood: Flooding of low-lying structures on the north side of the lagoon can occur from both a coastal flood (ocean surge) and from high flows in the Carmel River (see detail from Flood Insurance Rate Map, Monterey County, California, Panel 320 of 2050). The Lagoon reached levels above 12 feet (NGVD 1929) in both 2001 and 2008 from ocean surge, causing Monterey County to take emergency actions. Flood insurance claims on ten homes flooded during the two events were \$150,000; estimates are that the actual damage that was not covered by flood insurance (e.g., emergency response costs) was equal to the claims or an additional \$150,000. Thus total savings could be approximately \$300,000 per event. The Carmel River Flood Insurance Study Coastal Flooding Analysis (see below) describes an estimated return period for various lagoon water levels. Flooding of low-lying structural areas begins at about the 10-year return level. The floods of 2001 and 2008, which were caused by wave overtopping at the beach, are estimated to be between a 10 and 25-year return interval event. Damage is presumed to occur at the 25-year return event without the project. With a project, residential structures would be protected up to the 100-year level shown in the current Flood Insurance Study. At the 500-year return event, it was presumed that the barrier would fail to provide any protection from flooding. At levels above about the 25-year return event, between 10 and 24 residences area likely to benefit from installation of a wall.

Existing O&M to manually lower the beach to prevent flooding is estimated at \$93,000 annually. O&M costs after a barrier is installed are estimated to be \$90,000 annually for a net reduction of \$3,000 in O&M costs annually.

The DWR FRAM indicates a NPV of \$1,354,849.

Figure 1- Detail from Flood Insurance Rate Map, Monterey County, California, Panel 320 of 2050
 (note: elevations shown are NAVD 1988)

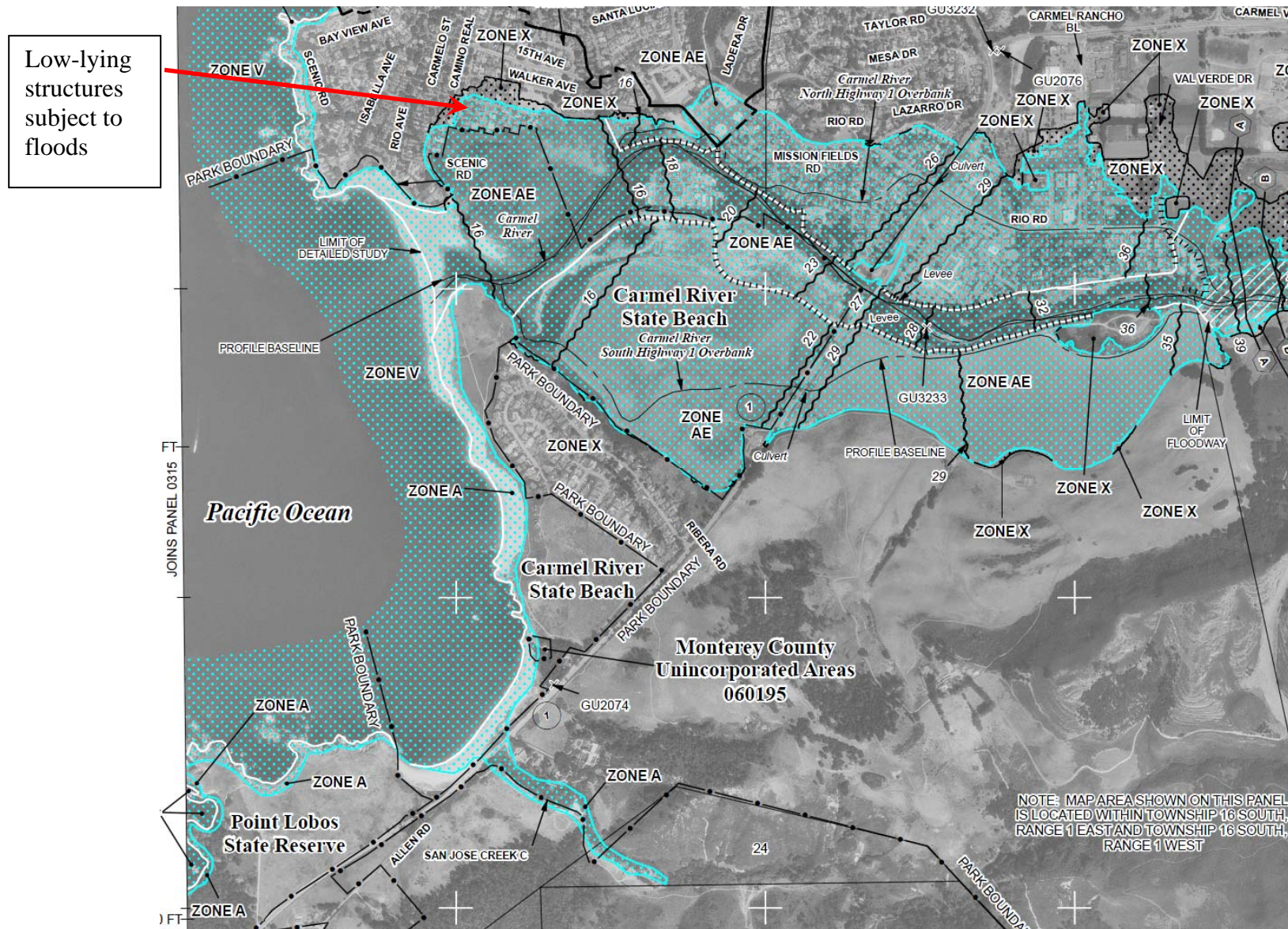


Figure 2

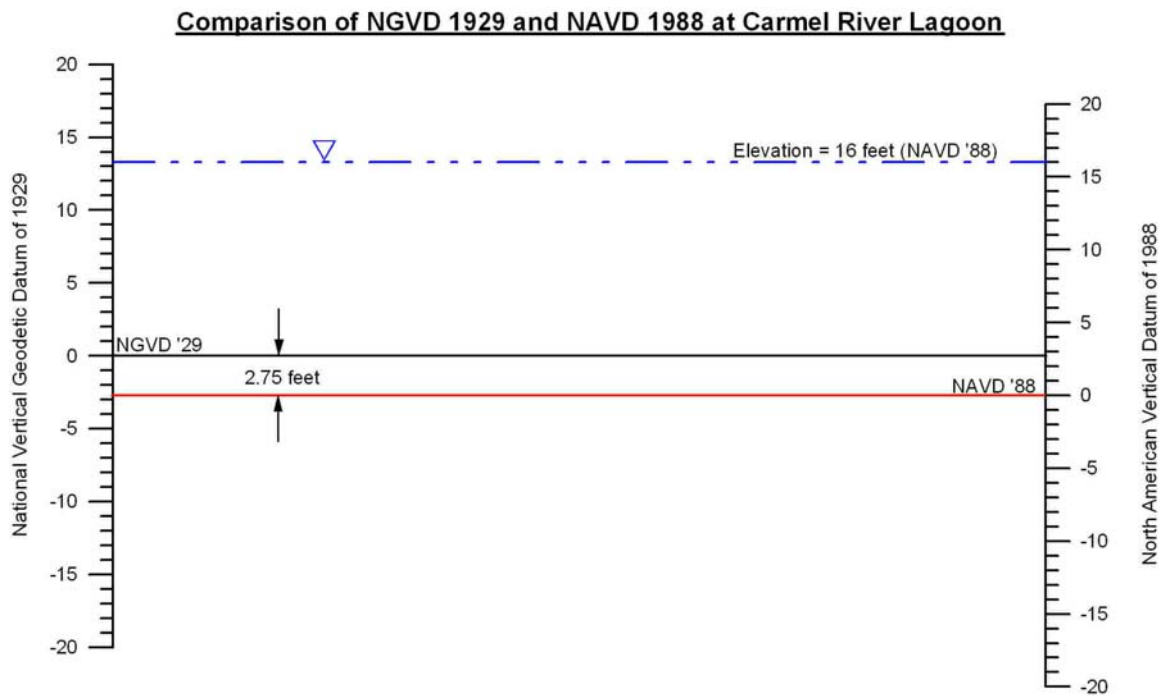


Table 17- Annual Cost of Project
(All costs should be in 2009 Dollars)
Project: Carmel River Lagoon and Beach Studies

	Initial Costs	Operations and Maintenance Costs (1)						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total cost From Table 7 (row (i), column (d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs (g) x (h)
2009							\$0	1.000	\$0
2010							\$0	0.943	\$0
2011	\$70,000	\$0	\$0	\$0	\$0	\$0	\$70,000	0.890	\$62,300
2012	\$165,500	\$0	\$0	\$0	\$0	\$0	\$165,500	0.840	\$139,020
2013	\$65,000	\$0	\$0	\$0	\$0	\$0	\$65,000	0.792	\$51,480
2014	\$1,135,000	\$0	\$0	\$0	\$0	\$0	\$1,135,000	0.747	\$847,845
2015	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.705	\$63,450
2016	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.665	\$59,855
2017	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.627	\$56,467
2018	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.592	\$53,271
2019	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.558	\$50,256
2020	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.527	\$47,411
2021	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.497	\$44,727
2022	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.469	\$42,196
2023	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.442	\$39,807
2024	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.417	\$37,554
2025	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.394	\$35,428
2026	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.371	\$33,423
2027	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.350	\$31,531
2028	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.331	\$29,746
2029	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.312	\$28,062
2030	\$0	\$10,000	\$40,000	\$40,000	\$75,000	\$0	\$165,000	0.294	\$48,536
2031	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.278	\$24,975
2032	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.262	\$23,562
2033	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.247	\$22,228
2034	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.233	\$20,970
2035	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.220	\$19,783
2036	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.207	\$18,663
2037	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.196	\$17,607
2038	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.185	\$16,610
2039	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.174	\$15,670
2040	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.164	\$14,783
2041	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.155	\$13,946
2042	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.146	\$13,157
2043	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.138	\$12,412
2044	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.130	\$11,709
2045	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.123	\$11,047
2046	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.116	\$10,421
2047	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.109	\$9,831
2048	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.103	\$9,275
2049	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.097	\$8,750
2050	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.092	\$8,255
2051	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.087	\$7,787
2052	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.082	\$7,347
2053	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.077	\$6,931
2054	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.073	\$6,539
2055	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.069	\$6,168
2056	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.065	\$5,819
2057	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.061	\$5,490
2058	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.058	\$5,179
2059	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.054	\$4,886
2060	\$0	\$10,000	\$40,000	\$40,000	\$0	\$0	\$90,000	0.051	\$4,609
Project Life	\$1,435,500	\$460,000	\$1,840,000	\$1,840,000	\$75,000	\$0	\$5,650,500	...	
Total Present Value of Discounted Costs (Sum of Column (i)) Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									\$2,166,774

Carmel River Flood Insurance Study Coastal Flooding Analysis

Northwest Hydraulic Consultants (**nhc**) was contracted by FEMA to conduct a Flood Insurance Study along an 18.9 mile reach of the Carmel River from San Clemente Dam downstream to the mouth at the Pacific Ocean. This study involved computing flood inundation limits and water levels for the 10, 2, 1, and 0.2 percent annual chance of occurrence flood events (10-, 50-, 100-, and 500-year return periods, respectively). The Carmel River flows into the Carmel Lagoon as it drains to the Pacific Ocean. Water levels in Carmel Lagoon are influenced by both Carmel River flows and ocean tides.

Monterey Peninsula Water Management District (MPWMD) has measured lagoon water levels at a recording stage gage since November 1987. Records indicate that peak water levels are controlled by a sand dune that forms at the mouth of the lagoon. These extreme lagoon water levels occurred when moderate river flows flowed into the lagoon and were backed up behind the sand dune. Large rainfall runoff events have not caused high lagoon water levels since, the MPWMD typically excavates a channel through the dune prior to large rainfall runoff events to increase the flow conveyance from the lagoon to the ocean. Extreme tide levels measured at a nearby NOAA tide gage were 5 to 7 feet below extreme lagoon water levels.

The available data suggests that extreme water levels within the lagoon are controlled by riverine processes and backwater due to a naturally forming dune at the mouth of the Carmel River. To better assess the coastal hazards in the Lagoon, **nhc** recommends that FEMA consider studying the potential for flooding due to wave overtopping and tsunamis as part of a large scale coastal analysis. The following analyses describe the water level frequency analyses conducted to assess the 10-, 50-, 100-, and 500-year lagoon water levels.

Methodology

nhc conducted a water level frequency analysis of recorded Carmel Lagoon annual maxima water levels and a frequency analysis of tide water level annual maxima recorded at Monterey Harbor (NOAA Gage 9413450). Annual peak water levels at the gage sites were evaluated using the Corp's flow frequency analysis program HEC-FFA (COE, 1993). These analyses used the computed station skew to calculate the frequency curve.

The Monterey Peninsula Water Management District (MPWMD) provided graphs of recorded lagoon water levels between 1992 and 2005. Peak water levels were selected for each month between 1992 and 2005. These values are summarized in Table 1. Annual peak water levels are shown in Table 2. The MPWMD states that lagoon water levels are controlled by water ponding behind dunes at the mouth of Carmel River. These annual peak lagoon water levels are not directly related to Carmel River peak flows or Pacific Ocean tides. Table 3 shows peak lagoon water levels measured near annual peak flows in the Carmel River.

nhc retrieved the Monterey Harbor annual peak tide water level records from the NOAA website (http://co-ops.nos.noaa.gov/data_res.html). These data were converted from the station

datum to NGVD29 vertical datum by subtracting 5.97 feet. Table 3 summarizes the annual peak tide data for the Monterey Harbor gage.

Table 1: Peak Monthly Water Levels (NGVD29) by Calendar Year

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Jan	-	7.0	10.0	6.3	8.9	9.6	7.9	9.4	10.0	11.3	12.04	9.6	7.9	9.6	8.5
Feb	-	9.0	10.0	9.0	8.7	8.6	8.6	9.4	6.8	6.1	7.3	9.0	9.4	9.9	7.9
Mar	-	-	8.9	9.4	8.7	7.4	9.4	6.2	9.0	6.9	9.2	8.9	9.2	8.6	10.2
Apr	-	-	8.1	8.2	5.7	9.8	8.4	6.8	5.3	8.0	7.4	6.4	9.9	8.9	7.4
May	-	7.4	8.2	7.6	7.0	7.2	8.1	9.2	6.5	9.0	8.0	8.2	7.5	7.2	8.6
June	-	-5.7	9.1	6.0	8.0	7.7	6.8	6.1	9.8	8.2	7.1	7.3	8.7	4.8	5.8
July	-	3.6	5.8	3.4	6.0	7.7	4.3	5.3	7.8	5.7	5.3	4.6	5.3	3.5	
Aug	3.6	3.0	4.6	3.0	7.0	3.7	3.5	5.1	3.9	4.0	4.1	3.5	3.5	4.5	
Sept	5.2	5.8	3.8	4.1	7.7	4.3	7.8	7.3	4.8	5.8	5.1	3.8	3.9	4.2	
Oct	4.6	7.3	5.1	4.7	6.7	6.5	6.8	9.8	7.3	6.7	5.6	5.3	5.6	6.0	
Nov	5.1	6.8	6.2	5.3	5.4	6.0	7.9	10.0	6.8	6.5	6.2	8.8	5.0	5.8	
Dec	6.8	6.7	6.8	5.6	9.3	9.7	10.5	8.5	5.7	8.9	10.8	10.8	10.5	10.3	

Water year begins on October 1st and ends September 30th. (e.g. Water Year 1992 extends from 10/1/91 to 9/30/92)

* All Water levels are NGVD29

Table 2: Summary of Peak Water Levels (NGVD29) by Water Year:

WY	Month / Cal Yr	Water Levels
1992	02/92	9.0
1993	02/93	10.0
1994	03/94	9.4
1995	01/95	8.9
1996	01/96	9.6
1997	12/96	9.7
1998	12/97	10.5
1999	01/99	10.0
2000	01/00	11.3
2001	01/01	12.0
2002	12/01	10.8
2003	04/03	9.9
2004	12/03	10.5
2005	12/04	10.3

Water year begins on October 1st and ends September 30th. (e.g. Water Year 1992 extends from 10/1/91 to 9/30/92)

* All Water Levels are NGVD29

Table 3: Peak Water Levels During Peak Annual Discharge at Carmel River Near Carmel Lagoon:

Date	Peak Discharge	Peak Water Level
2-15-92	3910	6.3
1-14-93	4940	6.1
2-20-94	636	4.8
3-10-95	16000	8.8
2-19-96	3360	6.3
1-29-97	5170	4.7
2-3-98	14600	6.6
2-9-99	2510	5.2
2-14-00	2450	6.0
3-5-01	2550	5.8
12-2-01	625	5.5
12-16-02	3470	10.8
2-25-04	3380	4.0

Water year begins on October 1st and ends September 30th. (e.g. Water Year 1992 extends from 10/1/91 to 9/30/92)

* All Water Levels are NGVD29

Results

The Carmel Lagoon 10-, 50-, 100-, and 500-year water level events are significantly greater than the water levels computed at the Monterey Harbor gage. These values are summarized in Table 4. **nhc** compared the Carmel Lagoon water level frequency quantiles to normal depth results from the riverine analysis. The higher of the two stage estimates was used to assess flood hazards in Carmel Lagoon.

Table 4. Water Level Quantiles for the Carmel Lagoon and Monterey Harbor Water Level Gages

Percent Chance Exceedance (Return Period)	Carmel Lagoon Peak Water Level	Monterey Harbor Peak Water Level
0.2 (500-Year)	13.4	5.6
1 (100-Year)	12.6	5.3
2 (50-Year)	12.2	5.2
10 (10-Year)	11.3	4.9

Summary

Peak lagoon water levels result from ponding of riverine flows behind the dune at the river mouth. The peak lagoon water levels due to ponding behind the dune are significantly greater than the still water elevations calculated using the Monterey Harbor tide gage data. The ponding analysis is described in Section 3.2 of the TSDN, Hydraulic Analyses of the Carmel River. The impact of wave overtopping on lagoon water levels was not analyzed. **nhc** recommends that FEMA consider studying the potential for flooding due to wave overtopping and tsunamis as part of a large scale coastal analysis.

References

U.S. Army Corps of Engineers (COE). 1992. HEC-FFA Flood Frequency Analysis Computer Program. May 1992.
<http://www.hec.usace.army.mil/publications/ComputerProgramDocumentation/CPD-13.pdf>

Federal Emergency Management Agency (FEMA). 2005. Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States. FEMA Region IX, Oakland, CA.

Project Name:	Carmel River Lagoon and Beach Studies
Cost of Project:	\$ 1,435,000
Description:	

Number of Events Modeled	5	Without Project						With Project					
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Average Return Interval (ARI)		10	25	50	100	500		10	25	50	100	500	
Annual Probability of Exceedance		0.900	0.040	0.020	0.010	0.002	#DIV/0!	0.100	0.040	0.020	0.010	0.002	#DIV/0!
Probability of Levee Failure		0.00	1.00	1.00	1.00	1.00		0.00	0.00	0.00	0.00	1.00	
Water Surface Elevation - channel (f)													
Flood Warning Time (hours)		0	0	0	0	0		0	0	0	0	0	
Flood Experience		N	N	N	N	N		N	N	N	N	N	
Period of Inundation (days)													
HEC-FIA DATA INPUTS		Y											
Residential Structural Damages (\$)		0	300,000	300,000	300,000	300,000		0	0	0	0	300,000	
Residential Contents Damages (\$)													
Residential Debris & Cleanup (\$)													
Commercial Structural Damages (\$)													
Commercial Contents Damages (\$)													
Commercial Debris & Cleanup (\$)													
Industrial Structural Damages (\$)													
Industrial Contents Damages (\$)													
Industrial Debris & Cleanup (\$)													
Agricultural Structural Damages (\$)													
Agricultural Contents Damages (\$)													
Agricultural Debris & Cleanup (\$)													
Residential Properties													
Ratio Depreciated Value to Replacement Value													
Average Flood depth above ground level (f)													
Rural - Res: Homesteads		10	10	10	24	24		0	0	0	0	24	
Rural - Other: Barns, sheds													
Urban Res: Single story (no base)													
Urban Res: Single story (basement)													
Urban Res: Two plus story (no base)													
Urban Res: Two plus story (basement)													
Mobile home													
Commercial Properties													
Ratio Depreciated Value to Replacement Value													
Average Flood depth above ground level (f)													
low value	building area inundated (sq.f.)												
medium value	building area inundated (sq.f.)												
high value	building area inundated (sq.f.)												
Industrial Properties													
Ratio Depreciated Value to Replacement Value													
Average Flood depth above ground level (f)													
low value	building area inundated (sq.f.)												
medium value	building area inundated (sq.f.)												
high value	building area inundated (sq.f.)												
Agricultural Production													
Corn	ac.												
Rice	ac.												
Walnuts	ac.												
Almonds	ac.												
Cotton	ac.												
Tomatoes	ac.												
Wine Grapes	ac.												
Alfalfa	ac.												
Pasture	ac.												
Safflower	ac.												
Sugar Beets	ac.												
Beans	ac.												
Other	ac.												
Roads													
length of arterial roads inundated (miles)													
length of major roads inundated (miles)													
length of minor roads inundated (miles)													
length of unsealed roads inundated (miles)													

Extrapolate Y-intercept	N
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Summary of Cost-Benefit Analysis

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Project Name: Carmel River Lagoon and Beach Studies

Description

0

Proposed project capital cost: \$ 1,435,000 [Note: construction costs which are assumed to occur in one year.]

Change in annual O&M costs: -\$ 3,000 [Note: the change in annual O&M costs compared to without project condition]

PV of future O&M costs: -\$ 47,286 (at 6% discount rate over 50 years)

PV of future costs \$ 1,387,714 [Note: the sum of capital costs plus the PV of O&M costs.]

Benefits

	Actual	Potential	
EAD without project	\$ 176,250	\$ 176,250	[Note: for stormwater projects use "Potential" damage which ignores stormwater damage reduction benefits]
EAD with project	\$ 2,250	\$ 2,250	
Annual Benefit:	\$ 174,000	\$ 174,000	
PV of Future Benefits:	\$ 2,742,564	\$ 2,742,564	(at 6% discount rate over 50 years)

Cost-Benefit Analysis

	Actual	Potential	
Net Present Value (NPV)	\$ 1,354,849	\$ 1,354,849	(at 6% discount rate over 50 years)
Benefit:Cost Ratio	1.976	1.976	

NPV Sensitivity to Discount Rate:	Actual	Potential
4%	\$ 2,302,900	\$ 2,302,900
5%	\$ 1,741,531	\$ 1,741,531
6%	\$ 1,307,564	\$ 1,307,564
7%	\$ 966,330	\$ 966,330
8%	\$ 693,626	\$ 693,626